WHAT IS CLAIMED IS:

1. Apparatus for leak detection comprising:

a first sealable chamber configured to receive a test piece containing a trace gas;

a second sealable chamber;

a first valve coupled between the first and second chambers;

a leak detector having a test port;

a trace gas permeable member coupled between the second chamber and the test port of the leak detector;

a vacuum pump having an inlet; and

a second valve coupled between the second chamber and the inlet of the vacuum pump.

2. Apparatus as defined in claim 1, wherein the leak detector comprises an ion pump.

3. Apparatus as defined in claim 1, wherein the permeable member is permeable to helium.

4. Apparatus as defined in claim 1, wherein the permeable member comprises a quartz member, the apparatus further comprising a heating element in thermal contact with the quartz member and a controller configured to control the heating element.

5. Apparatus for leak detection comprising:

a first sealable chamber configured to receive a test piece containing a trace gas;

a second sealable chamber;

a first valve coupled between the first and second chambers;

a leak detector including a test port and a vacuum pump;

a second valve coupled between the second chamber and the test port of the leak detector; and

a trace gas permeable member coupled between the second chamber and the test port of the leak detector.

6. Apparatus as defined in claim 5, wherein the second valve is closed at relatively high pressures in the second chamber and wherein the second valve is open at relatively low pressures in the second chamber.

7. Apparatus as defined in claim 5, wherein the permeable member comprises a quartz member, the apparatus further comprising a heating element in thermal contact with the quartz member and a controller configured to control the heating element.

8. Apparatus as defined in claim 5, wherein a trace gas permeability of the permeable member is controllable.

9. Apparatus as defined in claim 5, wherein the permeable member is permeable to helium.

10. A method for leak detection, comprising:

providing a first sealable chamber, a second sealable chamber and a first valve coupled between the first and second chambers;

placing a test piece containing a trace gas in the first chamber with the first valve closed;

vacuum pumping the second chamber with the first valve closed;

opening the first valve, wherein gas in the first chamber expands into the second chamber;

providing a trace gas permeable member coupled to the second chamber; and

detecting a leak in the test piece by sensing the trace gas that passed through the permeable member.

11. A method as defined in claim 10, further comprising vacuum pumping the second chamber with the first valve open, and sensing the trace gas pumped from the second chamber to provide detection of small leaks.

12. A method as defined in claim 11, further comprising controlling the permeable member at a high trace gas permeability at relatively high pressures in the second chamber and controlling the permeable member at a low trace gas permeability at relatively low pressures in the second chamber.

13. A method as defined in claim 12, wherein controlling the permeable member comprises heating the permeable member.

14. A method as defined in claim 10, wherein sensing the trace gas that passed through the permeable member comprises sensing the trace gas with an ion pump and monitoring ion pump current.

15. A method as defined in claim 10, wherein sensing the trace gas that passed through the permeable member comprises sensing the trace gas with a leak detector including a mass spectrometer.

16. A method as defined in claim 11, wherein sensing the gas pumped from the second chamber comprises sensing the trace gas with a leak detector.

17. Apparatus for leak detection comprising:

a first sealable chamber configured to receive a test piece containing a trace gas;

a second sealable chamber;

a first valve coupled between the first and second chambers;

a first leak detector including a test port and a vacuum pump;

a second valve coupled between the second chamber and the test port of the first leak detector;

a second leak detector having a test port; and

a trace gas permeable member coupled between the second chamber and the test port of the second leak detector.

18. Apparatus as defined in claim 17, wherein the second valve is closed at relatively high pressures in the second chamber and wherein said second valve is open at relatively low pressures in the second chamber.

19. Apparatus as defined in claim 17, wherein the permeable member comprises a quartz member, the apparatus further comprising a heating element in thermal contact with the quartz member and a controller configured to control the heating element.

20. Apparatus as defined in claim 17, wherein the trace gas permeability of the permeable member is controllable.

21. Apparatus as defined in claim 17, wherein the permeable member is permeable to helium.

22. Apparatus as defined in claim 17, wherein the second leak detector comprises an ion pump.